1. The OSGEO System
   - Open Source Remote Sensing Software
   - Usage Examples

2. Course Overview
   - Computing Environment
About Us

- **Pete Bunting**
  - Senior Lecturer at Aberystwyth University
  - Head of Earth Observation and Ecosystem Dynamics Group at AU.

- **Dan Clewley**
  - Post Doctoral Research Associate at the University of Southern California.
  - Working with Mahta Moghaddam in the Microwave Systems, Sensors and Imaging Lab (MiXIL).
  - Ph.D. supervised by Richard Lucas 2008 - 2011
Paradigm

- Shifting from small datasets to large.
  - For years scientists have demonstrated techniques on single images / study sites.
  - We now have large spatial and time series datasets available to us - opportunity to demonstrate techniques on larger datasets.

- From single core to multicore
  - How many Universities and institutions have invested in HPC equipment?
  - How can we effectively utilise this capability for Remote Sensing?

- Software licensed per core?
  - Does open source provide a better more flexible solution?
Raster Processing

1. **Storage**
   - Image data (with attribute tables)
   - Compression

2. **Processing Tools**
   - Needs to be scriptable
   - Ability to process large datasets and number of input images
   - Easy to use and extendible

3. **Visualisation**
   - Easy to use
   - Cross platform.
The Remote Sensing and GIS Software Library

- Started by Pete Bunting in April 2008 as a means of grouping together code developed as part of his research and to provide a better platform for development of new functions.
- Released under an open source (GPL) license in November 2009.
- Contains over 300 functions for processing vector and raster data.
- There are two main interfaces for RSGISLib, XML scripts and Python bindings - For this worksheet we focus on the newer Python bindings.
RSGISLib is not a complete solution and we use in combination with a number of open source projects. The main ones, which we’ll be using during this workshop, are:

- GDAL
- The KEA image format
- RIOS
- TuiView

With Python used to join together the different packages and produce processing chains.
Geospatial Data Abstract Library (GDAL)

- Provides a library for reading and writing image and vector formats
  - Supports a very wide variety of formats
- Includes a set of useful tools, such as
  - Translation between file formats (e.g., GeoTIFF to ENVI)
  - Reprojecting data
  - Polygonise / Rasterise
- Widely used in many software packages
  - Good, broad and activity community
- http://www.gdal.org
KEA image file format

- HDF5 based image file format
- GDAL driver
  - Therefore the format can be used in any GDAL compatible software (e.g., ArcMap)
- Support for large raster attribute tables
  - Used for classification
- zlib based compression
  - Small file sizes
  - 10 m SPOT mosaic of New Zealand 5GB per island (Each approx. 65000, 84000 pixels)
- Development funded and supported by Landcare Research, New Zealand.
- [Bunting and Gillingham(2013)]
Raster I/O Simplification (RIOS)

- A flexible Python framework for image processing
- Numpy and Scipy functions are easily accessible
- Very fast and simple development but scalable
- Framework for accessing GDAL raster attribute tables (RATs)
  - Object Oriented classification
- Developed by Sam Gillingham and Neil Flood
  - Queensland Government and Landcare Research, NZ
- [Gillingham and Flood(2013)]
TuiView

- Free and open source image viewer
  - Using GDAL and Python
- Fast and easy to use
- Light weight can be used from a remote server
- Developed by Sam Gillingham, Landcare Research, NZ
Python

- High level scripting language which is interpreted, interactive and object-oriented.
- Has clear and understandable syntax.
- Many libraries available for a variety of applications (try Googling an application and Python).
- To fully utilise the Python bindings of RSGISLib, and the other tools described here, knowledge of Python syntax is required.
- For this course a basic knowledge of Python will be helpful but is not required.
Examples of research using the software presented

- Biomass mapping in Australia - associated pre-processing.
- Regrowth Classification in Queensland, Australia using FPC and PALSAR data.
- National Land Cover Database in New Zealand.
- Biodiversity Multi-SOsource Monitoring System: From Space To Species (BIO_SOS)
- Wetland mapping in North America using JERS-1 and PALSAR data.
- Numerous PhD and MSc dissertations at Aberystwyth University.
Topics covered

- Some of the utility programs included with GDAL
- Data visualisation using TuiView
- Creating scripts with Python
- RSGISLib
  - Pre-processing
  - Image segmentation
  - Classification
  - Change detection
Course structure

Series of worked examples.

- We’ll provide an overview of each script then you’ll be given time to run.
- Highlights of scripts covered in slides.
- Complete scripts, with comments (lines starting with #), in notes and with course material.
- Brief description of commands in notes - links to more detailed explanation.
Linux Virtual Machine

- While a number of open source remote sensing projects are cross platform RSGISLib currently only runs under UNIX-like operating systems (e.g., Linux, OS X, Solaris).
- You have been provided a virtual machine running xubuntu (a variant of ubuntu)
The XFCE Desktop

Terminal

Text editor
The command line

- The software used for this course are accessed from the command line.
- Steeper learning curve then GUI tools but offer more power.
- Possible to script and batch process multiple data sets.
- Easy to translate to High Performance Computing (HPC) environments.
EnvMaster

- All the software used for this course have been built from source and installed to `/share/osgeo`
- A separate folder is used for each software and version.
- EnvMaster is used to update the paths, load and unload libraries, and swap versions.
- This is a common practice on managed systems (e.g., HPCs) where users require multiple versions of software.
- For personal machines it keeps things tidy and stops confusion between different versions.
- Makes the software stack portable and easier to deploy across multiple machines.
- Written by Sam Gillingham.
Data Location

- All the files used for this course are in the home folder under ‘RSGISLibCourse’
- Python scripts are within ‘Scripts’ and images are within ‘Data’
- Assume scripts are being run from data directory.
Change your working directory to the data directory by opening a terminal window and typing:

```bash
cd ~/RSGISLibCourse/Data
```

The scripts are provided in a separate directory and must be copied to the ‘Data’ directory, you can copy them one at a time, or all at once by typing:

```bash
cp ../*.py .
```
For complete beginners to python the codecademy.com python tutorials are recommend, covering:

- ‘Python Syntax’
- ‘Strings & Console Output’
- ‘Date and Time’
- ‘Conditionals & Flow Control’
- ‘Functions’
- ‘Python Lists and Dictionaries’
- ‘Lists and Functions’
- ‘Loops’
- ‘File Input / Output’

(http://www.codecademy.com/tracks/python)
Bibliography

